Abstract Submitted
for the FWS21 Meeting of
The American Physical Society

A Simulation Study of the Interaction of a Blasius Boundary Layer with a Roughness Element IAN SYSYN, PATRICK BONNER, FRANK JACOBITZ, University of San Diego, JONATHAN LEMARECHAL, MARCO COSTANTINI, German Aerospace Center (DLR) — Roughness elements on surfaces of transportation systems can contribute to the transition from laminar to turbulent flow, impacting the overall energy requirements due to increased drag, and improving the stability of lift forces. The present study considers the interaction of a Blasius Boundary Layer developing on a flat surface with a cylindrical roughness element of small aspect ratio and a height smaller than the local boundary layer thickness. Using Ansys CFD, the development of a horseshoe-shaped vortical structure around the roughness element as well as a recirculation zone directly downstream of the roughness element is observed. The simulations aim to reproduce previous experiments (J. Lemarechal et al., 2018) visualizing the flow structure through the use of temperature-sensitive paint (TSP) applied to a heated surface. The simulations and experiments qualitatively show the same vortical flow structure. A direct comparison of the surface temperatures in the roughness elements wake region yields a correlation coefficient of 0.85, also indicating strong quantitative agreement between simulations and experiments. The temperature signature is also a good indicator for regions of high wall shear stress. due to the horseshoe-vortex.

Frank Jacobitz
University of San Diego

Date submitted: 17 Sep 2021 Electronic form version 1.4